Geotechnical Engineering Report

VA Hospital Surgery Addition

1901 South First Street

Temple, Texas

August 11, 2014

Terracon Project No. 96145137

Prepared for:

Brewer & Escalante
Houston, Texas

Prepared by:

Terracon Consultants, Inc.
Austin, Texas

Terracon

August 11, 2014

Brewer & Escalante
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Attn: Mr. David S. Brewer, P.E.
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Re: Geotechnical Engineering Report
VA Hospital Surgery Addition
1901 South First Street
Temple, Texas
Terracon Project No. 96145137

Dear Mr. Brewer:

Terracon Consultants, Inc. (Terracon) is pleased to submit our Geotechnical Engineering Report for the VA Hospital Surgery Addition located at the VA Hospital facility at 1901 South First Street in Temple, Texas. We trust that this report is responsive to your project needs. Please contact us if you have any questions or if we can be of further assistance.

We appreciate the opportunity to work with you on this project and look forward to providing additional Geotechnical Engineering and Construction Materials Testing services in the future.

Sincerely,
Terracon Consultants, Inc.
(TBPE Firm Registration: TX F3272)

Edward E. Jaimes, E.I.T.
Staff Geotechnical Engineer

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EXECUTIVE SUMMARY

A geotechnical investigation has been performed for the proposed construction of the VA Hospital Surgery Addition located at the VA Hospital facility at 1901 South First Street in Temple, Texas. Subsurface conditions were evaluated using three borings drilled across the site.

Based on the information obtained from our subsurface exploration, the site can be developed for the proposed project. The following geotechnical considerations were identified:

- Stripping should include vegetation, concrete, asphalt, existing foundations, utilities, fill soils, and/or other miscellaneous materials unearthed after demolition.

- Once the subgrade is exposed and prior to placing any fill material, proofrolling should be performed to detect weak and/or soft areas. Weak areas should be removed and replaced with select fill or soils exhibiting similar characteristics as the adjacent in-situ soils.

- For the column loads anticipated for the proposed structures, drilled piers placed to bear in Stratum III Austin Chalk limestone are appropriate. Piers extending at least 4 feet into the Stratum III limestone may be sized using a maximum allowable total load bearing pressure of 40,000 psf and an allowable side friction of 6,000 psf for portions of the piers embedded beyond 4 feet.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. **Section 5.0 – GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
VA HOSPITAL SURGERY ADDITION
1901 SOUTH FIRST STREET
TEMPLE, TEXAS

Terracon Project No. 96145137
August 11, 2014

1.0 INTRODUCTION

Terracon is pleased to submit our Geotechnical Engineering Report for the proposed construction of the VA Hospital Surgery Addition located at the VA Hospital facility at 1901 South First Street located in Temple, Texas. The project was authorized by Mr. David S. Brewer, P.E., with Brewer & Escalante, through signature of our "Agreement for Services" on July 2, 2014. The project scope was performed in general accordance with Terracon Proposal No. P96140701, dated June 24, 2014.

The purpose of this report is to describe the subsurface conditions observed at the borings drilled for this project, analyze and evaluate the test data, and provide recommendations with respect to:

- Foundation design and construction recommendations;
- Site, subgrade, and fill preparation;
- Seismic site classification according to IBC 2012;
- Lateral earth pressure and drainage for site retaining walls; and
- Pavement design and construction.

2.0 PROJECT INFORMATION

2.1 Site Location and Description

Item	Description
Location	The project site is located at the VA Hospital facility located at 1901 South First Street in Temple, Texas (See Exhibit A-1, Site Aerial and Location Map, in Appendix A).
Existing Improvements	Existing hospital building, pavements, landscaping, and trees.
Current Ground Cover	Recently demolished building, truck docks, and pavements.
Existing Topography	Unknown at this time.

2.2 Project Description

Item	Description
Site layout	See Exhibit A-2, Boring Location Plan, in Appendix A.
Proposed Improvements	The project will include the construction of a building addition to the existing Buildings 163 and 204 at the VA hospital facility. The addition is planned to connect at the second floor to the east side of Building 163 and the south side of Building 204. The addition will have a basement level about 14 to 15 feet below grade.
Building Construction	Drilled piers into limestone.
Finished Floor Elevation, FFE	Unknown at this time.
Maximum Loads	Unknown at this time.
Grading	Unknown at this time.
Below-Grade Areas	14 to 15 feet below existing grades.

3.0 SUBSURFACE CONDITIONS

3.1 Geology

Based on our review of available geological information[1] and the recovered samples, the site lies in an area characterized by the Austin Group limestone belonging to the Upper Cretaceous Age. The Austin Group is generally comprised of tan to gray chalky limestone and marls, and is commonly overlain by a variable thickness of low to high plasticity clayey soils.

3.2 Typical Profile

Based on the results of the borings, subsurface conditions at the project site can be generalized as below.

Description	Approximate Depth Range of Stratum, feet	Material Encountered	Soil Consistency / Soil Density
Stratum Ia	0 to 6	Fill – Dark brown to brown fat clay with sand (CH) to sandy fat clay (CH) to sandy silt (ML) to clayey gravel (GC)	Very stiff to hard/Medium dense
Stratum I	4 to 7	Dark brown fat clay (CH)	Hard
Stratum II	5 to 27	Brown to light brown to light gray lean clay (CL) to lean clay with sand (CL)	Hard

[1] “Geologic Atlas of Texas – Waco Sheet”, Bureau of Economic Geology, The University of Texas at Austin, 1979.

Description	Approximate Depth Range of Stratum, feet	Material Encountered	Soil Consistency / Soil Density
Stratum III	19 to 50	Light brown to tan to gray to light gray limestone – Austin Chalk	-

1. The Stratum Ia fill soils encountered in all borings exhibited negligible to high shrink/swell potential as indicated by measured plasticity indices (PI's) of about 3 and 39 and fines contents of about 51 and 63 percent. In-situ moisture contents ranged from about 1 to 6 percent dry of the corresponding plastic limits. Hand penetrometer values ranged from about 4.0 to over 4.5 tons per square foot (tsf). Standard penetration resistance values (SPT N-values) ranged from about 11 blows per foot (bpf) of penetration to 26 bpf of penetration.
2. The Stratum I fat clay soils encountered in all borings exhibited very high shrink/swell potential as indicated by a measured PI of about 45. An in-situ moisture contents of about 4 percent dry of the corresponding plastic limit was recorded for the stratum. Hand penetrometer values of over 4.5 tsf were recorded for the stratum
3. The Stratum II lean clay soils encountered in all borings exhibited low to moderate shrink/swell potential as indicated by measured PI's ranging from about 19 to 26 (average of about 21) and fines contents ranging from about 81 to 87 percent (average of about 83 percent). In-situ moisture contents ranged from about 5 percent dry to 4 percent wet of the corresponding plastic limits. Hand penetrometer values ranged from 1.5 tsf to over 4.5 tsf. SPT N-values ranged from about 79 bpf to 50 blows for 1 inch of penetration. Unconfined compressive strength values ranged from about 1.5 to 6.3 tsf (average of about 3 tsf) with corresponding dry densities ranging from about 114 to 131 pound per cubic foot (pcf; average of about 126 pcf).
4. The Stratum III limestone encountered in all borings exhibited Recovery values ranging from about 40 to 100 percent (average of about 90 percent) and RQD values ranging from about 0 99 percent (average of about 69 percent). Unconfined compressive strength values ranged from about 104 to 183 tsf (average of about 137 tsf; 1897 psi) with corresponding dry densities ranging from about 138 to 146 pcf (average of about 143 pcf).

Conditions encountered at the boring locations are indicated on each individual boring log. Stratification boundaries on the boring logs represent the approximate location of changes in subsurface material types; in-situ, the transition between materials may be gradual. Details for the borings can be found on the boring logs on Exhibits A-4 through A-6 of Appendix A.

3.3 Groundwater

The borings were dry augered to depth of about 20 to 28 feet below grade. The borings were then drilled to completion depths of approximately 50 feet using wet rotary drilling techniques to facilitate rock coring. No groundwater was observed in any of the borings during drilling.

Although not encountered during our field program, groundwater at the site may be observed in the form of seepage traveling along pervious seams/fissures in the soil, along the soil/limestone interface, and/or in fissures/fractures in the limestone. During periods of wet weather, zones of seepage may appear and isolated zones of "perched water" may become trapped (or confined) by zones possessing a low permeability. Groundwater conditions at the site could fluctuate as a result of seasonal and climatic variations. Please note that it often takes several hours/days for water to accumulate in a borehole, and geotechnical borings are relatively fast, short-term boreholes that are backfilled the same day. Long-term groundwater readings can more accurately be achieved using monitoring wells. Please contact us if this is desired. Groundwater conditions should be evaluated immediately prior to construction.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

The following recommendations are based upon the data obtained in our field and laboratory programs, project information provided to us, and on our experience with similar subsurface and site conditions.

4.1 Geotechnical Considerations

Based on our test borings, highly to very highly expansive soils that exhibit a potential for volumetric change during moisture variations are present near the ground surface. The subgrade soils at this site may experience expansion and contraction due to changes in moisture content. The soils exhibit a Potential Vertical Rise (PVR) of up to about 2½ inches at the proposed building areas, as estimated by the Texas Department of Transportation (TxDOT) Method TEX-124-E, if present in a dry condition. However with anticipated below-grade cuts of about 14 to 15 feet, the basement level should overlie Stratum II lean clay soils, which exhibit a PVR of about one inch.

This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and cracking in the structures should be anticipated. The severity of cracking and other damage such as uneven floor slabs will probably increase if any modification of the site results in excessive wetting or drying of the subgrade soils. Eliminating the risk of movement and distress may not be feasible, but it may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction. We would be pleased to discuss other construction alternatives with you upon request.

Based on the field and laboratory data available, along with our previous experience, it is our opinion that drilled piers placed to bear into Stratum III Austin Group limestone would be appropriate to support the proposed building. Recommendations for this type of foundation system are presented in the following subsections, along with other geotechnical engineering considerations for this project.

4.2 Earthwork

Construction areas should be stripped of topsoil, vegetation, concrete, asphalt, wood, and all other miscellaneous debris and unsuitable material currently present at the site. All existing foundations should be completely excavated and removed to at least 2 feet below finished grades. If any unusual items are unearthed during or after demolition, please contact us for further evaluation. Utilities to be abandoned should be completely removed from all proposed construction areas. If this is not feasible, then the abandoned utility piping should be filled with flowable backfill and plugged such that it does not become a conduit for water flow. Roots of trees to be removed within construction areas should be grubbed to full depths, including the dry soil around the roots. Once final subgrade elevations have been achieved (including the over-excavation required for building pad), the exposed subgrade, should be carefully and thoroughly proofrolled with a 20-ton pneumatic roller or a fully-loaded dump truck to detect weak zones in the subgrade. Weak areas detected during proofrolling, as well as zones containing debris or organics, and voids resulting from removal of tree roots, existing foundation elements, utilities, etc., should be removed and replaced with soils exhibiting similar classification, moisture content, and density as the adjacent in-situ soils. Proper site drainage should be maintained during construction so that ponding of surface runoff does not occur and causes construction delays and/or inhibit site access.

Subsequent to proofrolling, and just prior to placement of fill, the exposed subgrade within the construction areas should be evaluated for moisture and density. If the moisture and/or density requirements do not meet the criteria described in the table below, the subgrade should be scarified to a minimum depth of 6 inches, moisture adjusted and compacted to at least 95 percent of the Standard Proctor (ASTM D 698) maximum dry density. Select fill and on-site soils should meet the following criteria.

Fill Type [1]	USCS Classification	Acceptable Location For Placement
Imported Select Fill [2,3]	CL, SC, and/or GC ($5 \le PI \le 20$)	Select fill material should be used for all grade adjustments within the building limits.
General Fill [4]	CH, CL, CL-ML, ML, SM, GC	General fill is for use within other non-structural areas. If paving fill is imported, the soils should not have a PI higher than 30.

1. Prior to any filling operations, samples of proposed borrow and/or on-site materials should be obtained for laboratory testing. The tests will provide a basis for evaluation of fill compaction by in-place density testing. A qualified soil technician should perform sufficient in-place density tests during the filling operations to evaluate that proper levels of compaction, including dry unit weight and moisture content, are being attained.
2. Imported select fill should consist of crushed limestone base material meeting the requirements of the Texas Department of Transportation (TxDOT) 2004 Standard Specifications Item 247, Type A, Grade 3, or a low-plasticity clayey soil with a plasticity index between 5 and 20 percent, a maximum gravel content (percentage retained on No. 4 sieve) of 40 percent, and rocks no larger than 4 inches in their largest dimension. Crushed concrete (per TxDOT Item 247, Type D, Grade 3 or

better) is also acceptable provided it is free of reinforcing steel and other miscellaneous objects. As an alternative, a low-plasticity granular fill material which does not meet these specifications may be used only if approved by Terracon.

3. Based on laboratory testing performed, the excavated Stratum Ia/I soils (typically dark brown in color) may not be used as select fill. We do not recommend these soils be considered for re-use as select fill when planning budgets. The Stratum II soils and Stratum III processed rock should be acceptable as select fill provided that it is processed such that a relatively well-graded grain size distribution with a maximum rock size of 4 inches is achieved and the plasticity index is less than 20 percent. Please note that removal of higher plasticity zones (typically dark brown to gray to light gray in color) within the Stratum II soils will be necessary to maintain plasticity indices of the material within the acceptable range. In some situations, the difference between more highly plastic clay and lower plasticity soils may not be readily distinguishable without the performance of appropriate laboratory testing. After initial processing of the fill material, samples should be submitted to Terracon for approval of proper gradation, plasticity index, and maximum rock size prior to use as select fill. We recommend that periodic testing be performed throughout the material excavation phase to check for conformance with the select fill requirements given above. The relative ease of mining and segregating the materials is unknown at this time.
4. Excavated on-site soils and processed rock, if free of organics, debris, and rocks larger than 4 inches, may be considered for use as fill in pavement, landscape, or other general areas. The use of rock fill in areas where underground utilities areas are planned will likely result in construction difficulties during trenching and excavation of the utility alignments. If utilities are to be placed in areas that are planned to receive rock fill, we recommend that the maximum rock size be limited to no greater than 4 inches for the full depth of the rock fill in these areas to reduce the potential for construction difficulties during utility trench excavation.
   - The maximum lift height recommended is 1.5 feet, which will be controlled by the maximum boulder size. A maximum nominal rock size of 9 inches should be maintained.
   - The largest nominal rock size of any given lift shall not exceed one-half of the lift height.
   - The upper 12 inches of the fill placement shall be composed of lifts no more than 6 inches in compacted thickness (8-inch loose lift thickness) and contain no rocks larger than 4 inches in their largest dimensions.
   - The rock fill shall be of sufficient size distribution such that no voids are present between larger rock sizes during placement.
   - Such a rock fill placement operation should be continuously monitored by Terracon personnel to check that the fill operation is in accordance with the recommendations stated herein. (In-place density testing for such a fill operation is often not practical.)
   - Please note that rock fills can create increased difficulty in terms of future excavation for utilities, etc. This should be considered prior to and during placement of the fill.

4.2.1 Compaction Requirements

Recommended compaction and moisture content criteria for engineered fill materials are as follows:

BENEATH SLAB AND ALL ASSOCIATED FLATWORK AREAS DEFINED AS BUILDING AREA LIMITS

Material Type and Location	Per the Standard Proctor Test (ASTM D 698)		
	Minimum Compaction Requirement (%)	Range of Moisture Contents for Compaction	
		Minimum	Maximum
Crushed Limestone Base	95	-3%	+3%
Imported Select Fill	95	-3%	+3%
Moisture Conditioned Building Pad Subgrade	95	-3%	+3%

BENEATH PAVEMENTS AND OTHER NON-STRUCTURAL AREAS OF THE SITE

Material Type and Location	Per the Standard Proctor Test (ASTM D 698)		
	Minimum Compaction Requirement (%)	Range of Moisture Contents for Compaction	
		Minimum	Maximum
Paving Subgrade and Fill with PI < 25	95	-3%	+3%
Paving Subgrade and Fill with PI ≥ 25	95	Optimum	+4%
Crushed Limestone Base (beneath pavements)	95 [1]	-3%	+3%

1. Per the Modified Proctor Test (ASTM D 1557)

Engineered fill materials should be placed in horizontal, loose lifts not exceeding 8 inches in thickness and should be thoroughly compacted. Where light compaction equipment is used, as is customary within a few feet of retaining walls and in utility trenches, the lift thickness may need to be reduced to achieve the desired degree of compaction.

We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

4.2.2 Grading and Drainage

The performance of the foundation system for the proposed structure will not only be dependent upon the quality of construction, but also upon the stability of the moisture content of the near-surface soils. Therefore, we highly recommend that site drainage be developed so that ponding of surface runoff near the structures does not occur. Accumulation of water near the structure's foundations may cause significant moisture variations in the soils adjacent to the foundations, thus increasing the potential for structural distress.

Positive drainage away from the structure must be provided during construction and maintained through the life of the proposed project. Infiltration of water into excavations should be prevented during construction. It is important that foundation soils are not allowed to become wetted. All grades must provide effective drainage away from the structures during and after construction. Exposed (unpaved) ground should be sloped at a minimum 5 percent away from the structures for at least 10 feet beyond the perimeter of the structures. Water permitted to pond next to the structures can result in greater soil movements than those discussed in this report. Estimated movements described in this report are based on effective drainage for the life of the structures and cannot be relied upon if effective drainage is not maintained.

Roof runoff and surface drainage should be collected and discharged away from the structure to prevent wetting of the foundation soils. Roof gutters should be installed and connected to downspouts and pipes directing roof runoff into storm water collection systems, or discharged onto positively sloped pavements.

Sprinkler mains and spray heads should preferably be located at least 5 feet away from the structures such that they cannot become a potential point source of water directly adjacent to the structures. In addition, the owner and/or builder should be made aware that placing large bushes and trees adjacent to the structures may cause significant moisture variations in the soils underlying the structures. In general, tree roots can adversely influence the subsurface soil moisture content to a distance of 1 to 1½ times the mature height of the tree and beyond the tree canopy. Watering of vegetation should be performed in a timely and controlled manner and prolonged watering should be avoided. Landscaped irrigation adjacent to the foundation units should be minimized or eliminated. Special care should be taken such that underground utilities do not develop leaks with time.

4.2.3 Below-Grade Excavation

Although we do not anticipate excavations for the proposed structure will approach the depth of the Stratum III limestone, it is quite possible for excavations within the Stratum I fill soils and the Stratum II soils to encounter limestone boulders, cobbles, fragments, seams, and layers, in addition to possible foundation and utility remnants.

If excavations deeper than the 14 to 15 foot cuts are planned, excavations may penetrate into the Stratum III limestone (estimated at ~EL 652 to 661 feet). Please note that our past experience with the Austin Chalk limestone, along with the data obtained during our field and laboratory programs, indicates that the upper portions of the limestone at this site should be rippable with proper equipment. However, zones of resistant limestone which could require sawcutting, jackhammering, hoe-ramming, milling, or similar techniques to excavate should be expected. In addition, the Austin Chalk limestone at this site typically became more competent with depth.

If possible, open cut conditions may be considered. Temporary excavations which could accommodate an open cut should be sloped at 1(V):1½(H) or flatter for the on-site Stratum Ia/I/II soils. Once the Stratum III limestone is encountered, temporary slopes of 1(V): 1/2(H) or flatter may be considered. A buffer area at least 5 feet wide, whichever is wider, should be maintained adjacent to streets, existing buildings, utilities, or other facilities to accommodate localized soil sloughing. The exposed slopes should be covered with plastic or other suitable protection to minimize erosion and drying out of surface soils. Any utilities or other critical facilities should be locally shored such that any sloughing of slopes will not undermine them.

In areas where open cut slopes will not be possible, an excavation retention system will be required to maintain a stable excavation. The most common retention systems utilized for downtown Austin projects typically involve drilled soldier pier systems, possibly in conjunction with tiebacks. The use of tiebacks along must be considered as a temporary system due to possible future excavations that could likely damage the tiebacks.

For the anticipated cuts, an equivalent fluid density of 50 pcf and 40 pcf for Stratum I/Ia/II soils and limestone, respectively (assuming an active earth pressure condition, which would allow for a limited degree of horizontal deflection of the wall system) should be considered for temporary retention system design. In movement-sensitive areas such as in close proximity to underground utilities, an equivalent fluid density of 70 pcf and 60 pcf should be utilized for Stratum I/Ia/II soils and Stratum III limestone, respectively, which assumes at-rest earth pressure conditions. In addition, surcharge loading should be included in temporary retention design. If the depth of the below-grade excavation increases and/or if groundwater is observed in the excavation, please contact Terracon to discuss the impact on the earth pressure presented above. Excavation retention systems should be designed by a licensed professional engineer experienced in the design of such systems.

OSHA Safety and Health Standards (29 CFR Part 1926) require that all excavations in excess of 5 feet deep be shored or appropriately sloped unless the sidewalls are comprised of “stable” rock. State of Texas legislation requires detailed plans and specifications for retention systems that meet OSHA standards for a safe construction environment during utilities installation. Prior to any construction, an excavation/trench safety plan, which is designed by a registered Professional Engineer, should be completed.

We recommend that a monitoring program be established to check the lateral deflection of temporary retention systems. Such a monitoring program will often detect areas of excessive deflection of the wall system, which could result in damage to adjacent streets, utilities, buildings, etc. Terracon would be pleased to assist in the development and implementation of such a monitoring program.

Our comments on excavation are based on our experience with the rock formation. Rock excavation depends on not only the rock hardness, weathering, and fracture frequency, but also the contractor's equipment, capabilities, and experience. Therefore, it should be the contractor's responsibility to determine the most effective methods for excavation. The above comments are intended for informational purposes for the design team only and may be used for planning purposes.

4.2.4 Temporary Groundwater Control

As previously mentioned, groundwater was not encountered at the site during the drilling process. Nonetheless, groundwater seepage is a possibility at this site for any open cut excavations. In addition, groundwater seepage may be encountered at higher elevations, especially after periods of wet weather and/or flood events. Temporary groundwater control during construction would typically consist of perimeter gravel-packed drains sloping toward common sump areas for groundwater collection and removal. Placement of drain laterals within the excavation could be required to remediate isolated water pockets.

4.3 Foundation System

As mentioned in **Section 4.1 – Geotechnical Considerations**, it is our opinion that a drilled straight-sided pier foundation system bearing in the Stratum III Austin Chalk limestone would be appropriate to support the proposed structures. Recommendations for this type of foundation system are provided below.

4.3.1 Design Recommendations - Drilled Piers

Principal column and wall loads for the proposed structure may be supported on drilled straight-sided piers embedded at least 4 feet into the Stratum III light brown to tan to light gray to gray Austin Group limestone.

Bearing pressures of piers founded in rock are dependent upon the secondary structure of the rock, as well as the compressive strength. Although these secondary features are taken into account in our recommendations, a pier should not be terminated on a clayey/shaley layer or a severely weathered zone within the Stratum III limestone. While drilling, the driller and field technician should be continuously monitoring for these softer layers. At locations where the design embedment results in the pier terminating on one of these secondary features, the pier should be extended deeper to bear at least one foot below the feature into competent limestone. Side friction may be counted above and below (but not within) these secondary features.

Description	Drilled Pier Design Parameter
Minimum embedment into bearing stratum [1]	4 feet
Minimum pier diameter	18 inches
Bearing pressure (net allowable)	40,000 psf

Description	Drilled Pier Design Parameter
Side Friction (net allowable)	6,000 psf for pier portions embedded beyond the minimum 4-foot embedment depth
Transient load increase for design parameters [2]	33%
Minimum percentage of steel [3]	0.5 percent
Approximate total settlement [4]	¾ inch
Estimated differential settlement [5]	Approximately ½ to ¾ of total settlement

1. To bear within the Stratum III Austin Chalk limestone.
2. For the evaluation of transient (temporary short-term) loading such as seismic or wind loads, the above design parameters can be increased by 33% per IBC 2012.
3. Soil-related uplift does not appear to be a concern at this site, assuming proper pier installation in limestone. However, we do recommend that the minimum percentage of reinforcing steel be no less than ½ percent of the gross shaft area and extend over the full length of the pier.
4. Provided proper construction practices are followed. For adjacent piers, we recommend a minimum edge-to-edge spacing of at least 1 pier diameter (or 2 pier diameters center-to-center) based on the larger diameter of the two adjacent piers. In locations where this minimum spacing criterion cannot be accomplished, Terracon should be contacted to evaluate the locations on a case-by-case basis.
5. Will result from variances in subsurface conditions, loading conditions and construction procedures, such as cleanliness of the bearing area or flowing water in the shaft.

Significant clay layers (6 inches in thickness or greater) and zones of highly weathered limestone (i.e. residual soils) should not be included in determining the required pier embedment into the rock. For example, if a one-foot thick clay layer is observed within the rock for a pier with a design embedment of 5 feet, the embedment into limestone should be extended to 6 feet. At locations where the design embedment results in the pier terminating on a severely weathered or clay layer, the pier should be extended to bear upon more competent limestone. Due to the subsurface conditions mentioned above, along with previous earthwork and planned cuts/fills, the total pier lengths will vary across each structure; therefore, appropriate base bid depths should be estimated for the project. Due to the fact that many of the piers will vary in length, the contract documents should include unit rates for additional drilled pier footage at various pier diameters. In addition, the construction budget for this project should include overages due to the likelihood of additional costs associated with extending many of the drilled piers to greater depths.

4.3.2 Grade Beams

Grade beams spanning between drilled pier foundation units may be cast at grade provided the subgrade in the beam areas is prepared as outlined in **Section 4.4**. Grade beams should be designed to span across the drilled pier foundations without subgrade support, due to potential stress-strain incompatibility between different bearing materials.

We recommend that on-site clayey soils (at least 18 inches deep) be used for backfill adjacent beams at the exterior of the buildings (to reduce potential infiltration of surface water into the subgrade in these areas). The exterior clayey backfill should be compacted to at least 95 percent of the ASTM D 698 dry density at a moisture content at or above optimum moisture. On the interior sides of the perimeter grade beams, backfill should consist of properly compacted select fill or flowable backfill (TxDOT Item 401), not sand or gravel.

4.3.3 Foundation Construction Considerations

Drilled pier foundations should be augered and constructed in a continuous manner. Concrete should be placed in the pier excavations following drilling and evaluation for proper bearing stratum, embedment, and cleanliness. The piers should not be allowed to remain open overnight before concrete placement. Surface runoff or groundwater seepage accumulating in the excavation should be pumped out and the condition of the bearing surface should be evaluated immediately prior to placing concrete. The drilling equipment used should be readily capable of excavating the Austin Chalk limestone observed at this site. Drilling equipment with insufficient torque and/or augers/bits/core barrels that are not suited for variable and/or hard rock conditions will likely result in poor production rates. In addition, the pier excavation may encounter obstructions such as utilities from previous construction at this site and large cobbles and boulders. The contractor should have equipment readily capable of penetrating concrete obstructions and similar conditions that might be present from previous development at this site.

Although not observed during our field exploration, zones of groundwater inflow and/or sloughing soils are a possibility during pier construction at this site. Therefore provisions must be incorporated into the plans and specifications to use casing to control sloughing and/or groundwater seepage during pier construction. Removal of the casing should be performed with extreme care and under proper supervision to minimize mixing of the surrounding soil and water with the fresh concrete. If water infiltration becomes excessive, slurry drilling techniques (or other drilling means) could be necessary.

Concrete should exhibit slump as stated in the Structural Engineer’s specifications. Under no circumstances should loose soil be placed in the space between the casing and the pier sidewalls. The concrete should be placed using a rigid tremie or by the free-fall method provided the concrete falls to its final position through air without striking the sides of the hole, the reinforcing steel cage or any other obstruction. A drop chute should be used for this free-fall method.

The use of casing should help to minimize groundwater inflow into the pier excavation. If seepage persists even after casing installation, the water should be pumped out of the excavation immediately prior to placing concrete. If groundwater inflow is too severe to be controlled by pumping, the concrete should be tremied to the full depth of the excavation to effectively displace the water. In this case, a “clean-out” bucket should be used to remove loose soil and/or rock fragments from the pier bottom before placing steel and concrete.

4.3.3.1 Foundation Construction Monitoring

The performance of the foundation system for the proposed structure will be highly dependent upon the quality of construction. Thus, we recommend that the foundation installation be monitored by Terracon to identify the proper bearing strata and depths and to help evaluate foundation construction. We would be pleased to develop a plan for foundation monitoring to be incorporated in the overall quality control program.

4.3.4 Connection of Existing and Proposed Structures

We understand that the proposed addition will be built adjacent to existing structures. We assume that the existing structures are supported on drilled piers, however do not know any details regarding the existing foundations and whether our assumptions are correct. Due to the independence of the existing foundation system and the planned improvements, it is possible that differential movements may occur between the existing and new foundation systems. The magnitude of differential movement will be primarily dependent on the quality of foundation construction used for the existing building and for the proposed improvements. Therefore, any members or connections of the addition which are common to the foundation of the adjacent structure should be designed such that they are tolerant to movement whenever possible. Any existing beams/footings adjacent to the excavation should be properly braced/shored to insure minimal distress to the existing structure and care should not be taken not to undermine any existing foundation elements, when performing subgrade excavations immediately adjacent to the existing structure.

4.4 Floor Slab Subgrade Preparation

Although the exact FFE of the structure has not been provided to us, we have been informed that the lowest level of the structure will be located approximately 14 to 15 feet below existing surface grades. This excavation places the lowest level of the structure within the Stratum II lean clay soils. If this information changes, Terracon should be notified to review and modify and/or verify recommendations in writing.

For the proposed structure, the floor slab for the structure is expected to be placed upon the Stratum II lean clay soils approximately 14 to 15 feet below existing grades. In order to provide a relatively flat bearing surface, the Stratum II lean clay soils should be overexcavated to provide at least 12 inches of properly compacted select fill underneath the building area. If Stratum III limestone is encountered, the select fill requirements may be reduced to 6 inches.

Material and placement requirements for select fill, as well as other subgrade preparation recommendations, are presented in **Section 4.2 – Earthwork**. We suggest the use of crushed limestone base as the select fill material from a standpoint of construction access, as well as from a standpoint of floor slab support. This suggestion is primarily to provide a better working surface for construction workers, equipment, and traffic on the building pad. Crushed limestone base material is not intended to function as a capillary break, moisture barrier, or drainage aggregate for the slab. **All fill placed within structures areas must meet the select fill requirements**.

For any flatwork (sidewalks, ramps, etc.) outside of the structure footprint which will be sensitive to movement, subgrade preparation as discussed above should be considered to reduce differential movements between the flatwork and the adjacent buildings.

4.5 Seismic Design Information

Code Used	Seismic Design Category	Site Classification
2012 International Building Code (IBC)	A[1]	B[2]

1. Per IBC 2012 Section 1613.3.1.
2. Per IBC 2012 Table 1613.3.2. The 2012 IBC requires a site soil profile determination extending a depth of 100 feet for seismic site classification. The current scope does not include the required 100-foot soil profile determination. Borings extended to a maximum depth of approximately 50 feet and this seismic site class definition assumes that materials with similar characteristics are below the maximum depth of the subsurface exploration. Additional exploration to deeper depths would be required to confirm the conditions below the current depth of exploration. Alternatively, a geophysical exploration could be used in order to attempt to justify a higher seismic class. If you desire parameters for earlier versions of IBC, please contact us.

Ground Motion Parameter	Value (g)[1]
S_s	0.067
S_1	0.039
S_{MS}	0.067
S_{M1}	0.039
S_{DS}	0.045
S_{D1}	0.026

1. Site Latitude 31.0763°N and Longitude 97.3473°W.

4.6 Lateral Earth Pressures

Presented below are at-rest, active, and passive earth pressure coefficients for various backfill types adjacent to below-grade walls or site retaining walls. At-rest earth pressures are recommended in cases where little wall yield is expected (such as structural below-grade walls). Active earth pressures may be utilized in cases where the walls can exhibit a certain degree of horizontal movement (such as cantilevered retaining walls).

BACKFILL TYPE	ESTIMATED TOTAL UNIT WEIGHT (PCF)	LATERAL EARTH PRESSURE COEFFICIENTS[1]		
		AT REST (K_O)	ACTIVE (K_A)	PASSIVE (K_P)
Crushed Limestone	135	0.45	0.3	3.5
Clean Sand	120	0.5	0.35	3.0
Clean Gravel	120	0.45	0.3	3.5
Stratum II Lean Clay	130	0.58	0.41	2.46
On-site Stratum III Crushed/Processed Rock [2]	135	0.45	0.30	3.5

1. Coefficients represent ultimate values. Appropriate safety factors should be applied.
2. Contingent upon preparation of the on-site Stratum III limestone as recommended in **Section 4.2 – Earthwork**.

The above values do not include a hydrostatic or ground-level surcharge component. To prevent hydrostatic pressure build-up, retaining walls should incorporate functional drainage (via free-draining aggregate or manufactured drainage mats) within the backfill zone. The effect of surcharge loads, where applicable, should be incorporated into wall pressure diagrams by adding a uniform horizontal pressure component equal to the applicable lateral earth pressure coefficient times the surcharge load, applied to the full height of the wall.

The compactive effort should be controlled during backfill operations adjacent to walls. Overcompaction can produce lateral earth pressures in excess of at-rest magnitudes. Compaction levels adjacent to walls should be maintained between 95 and 100 percent of Standard Proctor (ASTM D 698) maximum dry density.

For site retaining walls bearing on on-site Stratum Ia/I/II soils, we recommend a coefficient of sliding resistance of 0.4 (maximum allowable sliding resistance of 500 psf) and a maximum footing bearing capacity of 2,500 psf. All retaining walls should be checked against failure due to overturning, sliding, and overall slope stability. Such an analysis can only be performed once the dimensions of the wall and cut/fill scenarios are known. Structural below-grade walls that are part of the overall structure should be supported on drilled piers per **Section 4.3.1**.

We recommend that a buffer area of at least 5 feet for all pavement areas be placed between retaining walls (with a minimum height of 4 feet or more), and the adjacent construction. In building areas, this buffer zone from retaining walls should be increased to at least 10 feet. These recommended buffer zones are to reduce the potential of distress from any long-term ("creep") movements of the wall and backfill. Pedestrian sidewalks may be exempted from the above criteria; however, some distress could still be observed in the sidewalks due to movements of the retaining walls and backfill.

A wall drain (consisting of freely-draining aggregate or manufactured drainage mat, along with outlet piping) is recommended for collection and removal of surface water percolation behind the walls. Proper control of surface water percolation will help to prevent buildup of higher wall pressures. In unpaved areas, the final 12 inches of backfill should preferably consist of clayey soils to help to reduce percolation of surface water into the backfill.

4.6.1 Below-Grade Wall and Slab Drainage

We recommend that a permanent perimeter drainage system be designed adjacent to the below-grade walls along the perimeter of the below-grade level.

Drains should be constructed at the base of below-grade walls to reduce the risk of hydrostatic loading from water accumulated from surface runoff or other sources (pipe leaks etc.) at the basement walls. The drain pipe should be located with its invert at least 12 inches below the bottom of the lowest adjacent floor slab and should be surrounded with free-draining granular material, preferably consisting of a clean, washed gravel section (per ASTM C33, Grades 57 or 67, or similar material that is approved by Terracon) continuously wrapped in filter fabric (meeting TxDOT DMS-6200, Type I fabric). A 1.5-foot wide layer of this free-draining granular material should be placed adjacent to the wall. If located between the structure wall and the retention system, the granular material should extend from the drainage pipes to at least 2 feet above floor slab elevation. Select fill materials can then be placed over the filter fabric of the drainage system compacted as recommended in **Section 4.2 - Earthwork** of this report.

If the permanent structure wall is cast directly against the temporary retention system, then this perimeter drainage trench will need to be located just inside the structure perimeter walls with periodic connections provided between the drainage composite between the permanent wall/retention system and the interior perimeter drainage trench.

The drainage pipes should be perforated pipes with a minimum diameter of 4 inches placed near the bottom of the free-draining granular material. The perimeter drains should be sloped to provide positive gravity drainage to sumps equipped for automated pumping or to a down gradient storm sewer or other suitable outlet that will allow gravity drainage. Periodic maintenance of drainage systems is necessary so that they do not become plugged and inoperative.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide testing and observation during excavation, grading, foundation installation, and other construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include, either specifically or by implication, any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials, or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

For any excavation construction activities at this site, all Occupational Safety and Health Administration (OSHA) guidelines and directives should be followed by the Contractor during construction to provide a safe working environment. In regards to worker safety, OSHA Safety and Health Standards require the protection of workers from excavation instability in trench situations.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION

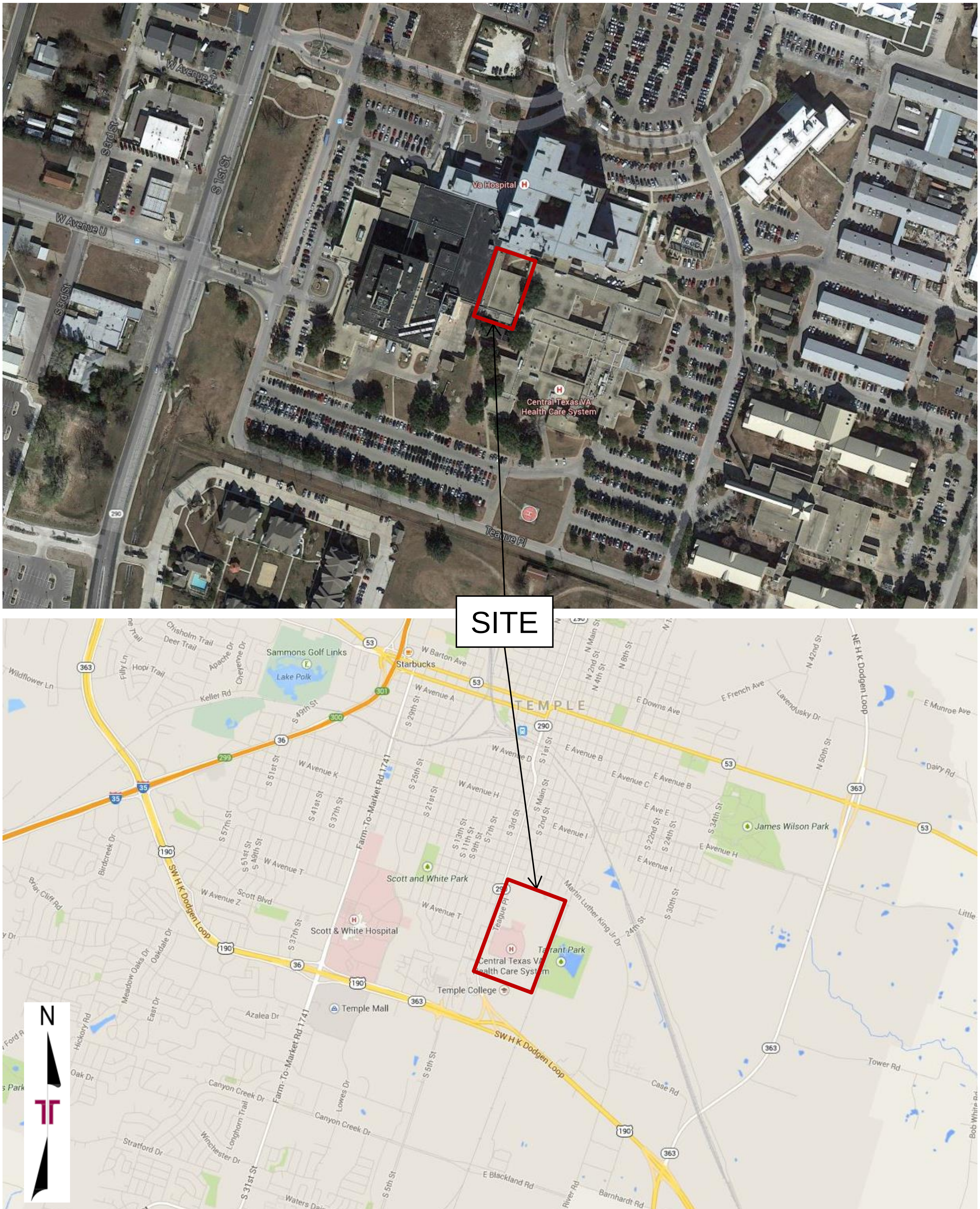


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Mgr: EEJ	Project No. 96145137	Terracon Consulting Engineers & Scientists	SITE AERIAL AND LOCATION MAP	EXHIBIT
Drawn By: EEJ	Scale: NTS	5307 Industrial Oaks Blvd, Suite 160, Austin, Texas 78735	VA Hospital Surgery Addition	A-1
Checked By: BSM	File Name: 96145137	PH. (512) 442-1122 FAX. (512) 442-1181	1901 South First Street	
Approved By: BSM	Date: July 21, 2014		Temple, Texas	

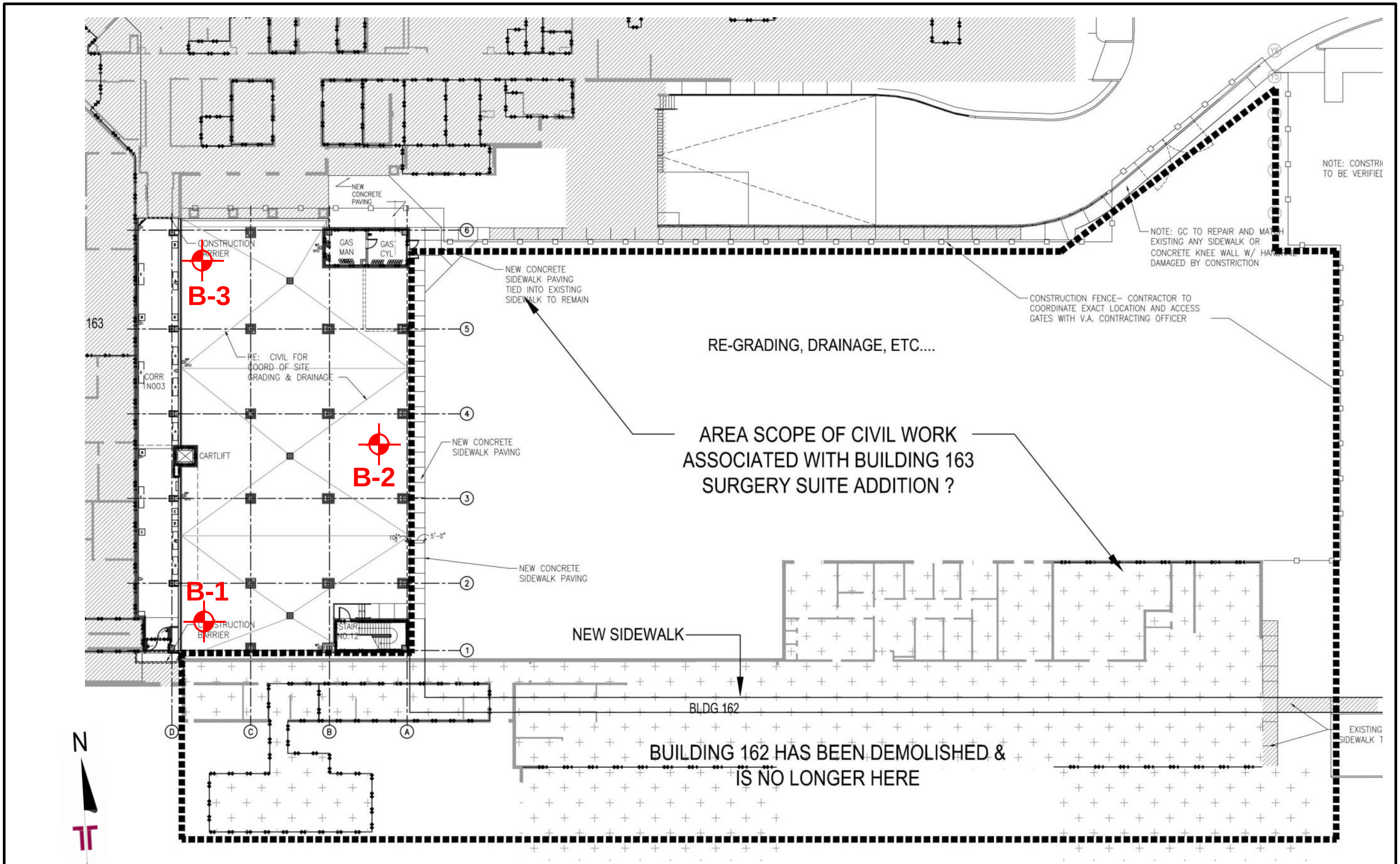


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: EEJ	Project No. 96145137
Drawn by: EEJ	Scale: N.T.S
Checked by: BSM	File Name: 96145137
Approved by: BSM	Date: July 21, 2014

Terracon
Consulting Engineers & Scientists

5307 Industrial Oaks Blvd, St 160 Austin, Texas 78735
PH. (512) 442-1122 FAX. (512) 442-1181

BORING LOCATION PLAN

VA Hospital Surgery Addition
1901 South First Street
Temple, Texas

Exhibit

A-2

Field Exploration Description

Subsurface conditions were evaluated by drilling three borings (B-1 through B-3) to depths of about 50 feet. The borings were drilled with truck-mounted rotary drilling equipment at the approximate locations shown on Exhibit A-2 of Appendix A. Boring depths were measured from the existing ground surface at the time of our field activities. The boring coordinates were located in the field through the use of a Garmin handheld GPS unit. The coordinates are presented on the top of the boring logs. Boring elevations were estimated using Google Earth® software.

The boring logs, which include the subsurface descriptions, types of sampling used, and additional field data for this study, are presented on the boring logs in Appendix A. Criteria defining terms, abbreviations and descriptions used on the boring logs are presented in Appendix C.

When possible, surficial soil samples were recovered using thin-walled, open-tube samplers (Shelby tubes). A pocket penetrometer test was performed on each sample of cohesive soil in the field to serve as a general measure of consistency.

Soils for which good quality tube samples could not be obtained and weathered rock were sampled by means of the Standard Penetration Test (SPT). This test consists of measuring the number of blows required for a 140-pound hammer free falling 30 inches to drive a standard split-spoon sampler 12 inches into the subsurface material after being seated 6 inches. This blow count or SPT “N” value is used to estimate the engineering properties of the stratum. A CME automatic SPT hammer was used to advance the split-barrel sampler in the borings performed on this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT values and soil properties are based on the lower efficiency cathead and rope method. This higher efficiency affects the standard penetration resistance blow count (N) value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

Once competent rock was encountered, the borings were advanced with Nx coring equipment. Visual classifications of all of the samples were performed in the field and percentages of Recovery and Rock Quality Designation (RQD) were calculated from recovered rock cores. Recovery is defined as the percentage of core recovered as a function of the length of core run drilled. The RQD is a modified measurement of core recovery which indirectly takes into account fractures and/or softening in the rock mass by summing up only pieces of sound core which are 4 inches or greater in length as a percentage of the total core run.

Samples were removed from the samplers in the field, visually classified, and appropriately sealed in sample containers to preserve the in-situ moisture contents. Samples were then placed in core boxes for transportation to our laboratory in Austin, Texas.

BORING LOG NO. B-1

PROJECT: VA Hospital Surgery Addition

CLIENT: Brewer & Escalante
Houston, TX 77040

SITE: 1901 South First Street
Temple, Texas

LOCATION See Exhibit A-2
Latitude: 31.0765° Longitude: -97.3473°

Approximate Surface Elev: 680 (Ft.) +/-

DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) RQD (%)	TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FILL - FAT CLAY WITH SAND (CH), dark brown, hard					4.5+ tsf (HP)					15			
	-with gravel at 2 feet					4.5+ tsf (HP)					18			
4.0		676+/-												
	FAT CLAY (CH), trace sand, dark brown, hard		5			4.5+ tsf (HP)					21		70-25-45	
6.0		674+/-												
	LEAN CLAY WITH SAND (CL), brown to light brown, hard, with calcareous deposits					4.5+ tsf (HP)		UC	2.27	1.8	12	102		
						4.5+ tsf (HP)					13			
	-with light gray clay seams beginning at 10 feet		10											
						4.5+ tsf (HP)					14		38-19-19	82
			15											
	-becomes light gray at 17 feet					37-50/1"								
19.0		661+/-												
	LIMESTONE, tan to light gray, moderately soft to moderately hard, moderately to highly fractured		20				72 27							
			25				80 27	UC	104.48		11	130		
			30											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 20 feet; Wet Rotary 20 to 50 feet

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
No free water observed

Terracon
5307 Industrial Oaks Blvd., Suite 160
Austin, Texas

Boring Started: 7/21/2014 | Boring Completed: 7/21/2014
Drill Rig: Mobile B-59 | Driller: Core Tech Drilling, Inc.
Project No.: 96145137 | Exhibit: A-4

BORING LOG NO. B-1

PROJECT: VA Hospital Surgery Addition

SITE: 1901 South First Street, Temple, Texas

CLIENT: Brewer & Escalante, Houston, TX 77040

LOCATION See Exhibit A-2
Latitude: 31.0765° Longitude: -97.3473°
Approximate Surface Elev: 680 (Ft.) +/-

DEPTH / Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) / RQD (%)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
LIMESTONE, tan to light gray, moderately soft to moderately hard, moderately to highly fractured *(continued)*						95 / 82							
		35				100 / 83	UC	158.08		6	138		
-soft brown clayey seam from about 43 to 43.5 feet		40				100 / 92	UC	109.04		7	136		
		45				100 / 92							
50.0	630+/-	50											
Boring Terminated at 50 Feet													

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 20 feet; Wet Rotary 20 to 50 feet

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
5307 Industrial Oaks Blvd., Suite 160
Austin, Texas

Boring Started: 7/21/2014	Boring Completed: 7/21/2014
Drill Rig: Mobile B-59	Driller: Core Tech Drilling, Inc.
Project No.: 96145137	Exhibit: A-4

BORING LOG NO. B-2

PROJECT: VA Hospital Surgery Addition

CLIENT: Brewer & Escalante
Houston, TX 77040

SITE: 1901 South First Street
Temple, Texas

LOCATION See Exhibit A-2
Latitude: 31.0763° Longitude: -97.3472°

Approximate Surface Elev: 679 (Ft.) +/-

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) RQD (%)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FILL - SANDY SILT (ML), brown, hard					4.0 tsf (HP)					10		19-16-3	51
						4.5+ tsf (HP)					8			
4.0	**FAT CLAY (CH)**, dark brown, hard	675+/-												
5.0	**LEAN CLAY WITH SAND (CL)**, brown to light brown, hard	674+/-	5			4.5+ tsf (HP)					21			
						4.5+ tsf (HP)					13		36-16-20	83
						4.5+ tsf (HP)		UC	6.32	4.3	13	115		
			10											
12.0	**LEAN CLAY (CL)**, brown to light brown, hard, with calcareous deposits	667+/-												
						31-33-46 N=79					13		39-18-21	
			15											
						50/5"								
			20											
						37-50/5"								
			25											
27.0	**LIMESTONE**, light brown to light gray, moderately soft, highly fractured	652+/-												
							88 / 31							
			30											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 28 feet; Wet Rotary 28 to 50 feet

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
5307 Industrial Oaks Blvd., Suite 160
Austin, Texas

Boring Started: 7/21/2014	Boring Completed: 7/21/2014
Drill Rig: Mobile B-59	Driller: Core Tech Drilling, Inc.
Project No.: 96145137	Exhibit: A-5

BORING LOG NO. B-2

PROJECT: VA Hospital Surgery Addition

CLIENT: Brewer & Escalante
Houston, TX 77040

SITE: 1901 South First Street
Temple, Texas

LOCATION See Exhibit A-2
Latitude: 31.0763° Longitude: -97.3472°

Approximate Surface Elev: 679 (Ft.) +/-

DEPTH / ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) / RQD (%)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LIMESTONE, light brown to light gray, moderately soft, highly fractured *(continued)* -becomes light gray, moderately soft to moderately hard, and moderately fractured at 31.5 feet	35				100 / 72	UC	135.17		9	134		
	-unfractured from 36 to 38 feet					95 / 95							
	-partial slickensided surface encountered at 39 feet -becomes gray at 40 feet -moderately to highly fractured from 42 to 50 feet	40				92 / 83	UC	125.55		12	128		
		45				87 / 82							
50.0 / 629+/-	***Boring Terminated at 50 Feet***	50											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 28 feet; Wet Rotary 28 to 50 feet

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
No free water observed

Terracon
5307 Industrial Oaks Blvd., Suite 160
Austin, Texas

Boring Started: 7/21/2014	Boring Completed: 7/21/2014
Drill Rig: Mobile B-59	Driller: Core Tech Drilling, Inc.
Project No.: 96145137	Exhibit: A-5

BORING LOG NO. B-3

PROJECT: VA Hospital Surgery Addition

CLIENT: Brewer & Escalante
Houston, TX 77040

SITE: 1901 South First Street
Temple, Texas

LOCATION See Exhibit A-2
Latitude: 31.0762° Longitude: -97.3475°

Approximate Surface Elev: 678 (Ft.) +/-

DEPTH	DESCRIPTION	ELEVATION (Ft.)
0.6	4" CONCRETE	677.5+/-
2.0	3" BASE MATERIAL **FILL - CLAYEY GRAVEL (GC)**, brown, medium dense	676+/-
6.0	**FILL - SANDY FAT CLAY (CH)**, dark brown to brown, very stiff	672+/-
7.0	**FAT CLAY (CH)**, dark brown, hard	671+/-
25.0	**LEAN CLAY (CL)**, brown to light brown, stiff to hard, with dark brown laminated clay seams -with light gray clay seams at 13 feet -becomes light gray and with sand at 23 feet	653+/-
	LIMESTONE, light brown to tan to light gray, moderately hard, highly to intensely fractured	

DEPTH (Ft.)	FIELD TEST RESULTS	RECOVERY (%) RQD (%)	TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5–2	8-5-6 N=11					4			
2.5–4	19-11-15 N=26					18			
4.5–6	9-12-10 N=22					18		58-19-39	63
6–8	4.5+ tsf (HP)					17			
8–10	4.5+ tsf (HP)					13			
13–15	4.5+ tsf (HP)					13			
18–20	1.5 tsf (HP)		UC	1.96	13.5	19	107	41-15-26	87
23–25	4.5+ tsf (HP)		UC	1.48	5.2	16	113	38-18-20	81
27–30		40 0							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 27 feet; Wet Rotary 27 to 50 feet

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
No free water observed

Terracon
5307 Industrial Oaks Blvd., Suite 160
Austin, Texas

Boring Started: 7/16/2014	Boring Completed: 7/16/2014
Drill Rig: Mobile B-59	Driller: Core Tech Drilling, Inc.
Project No.: 96145137	Exhibit: A-6

BORING LOG NO. B-3

PROJECT: VA Hospital Surgery Addition

CLIENT: Brewer & Escalante
Houston, TX 77040

SITE: 1901 South First Street
Temple, Texas

LOCATION See Exhibit A-2
Latitude: 31.0762° Longitude: -97.3475°
Approximate Surface Elev: 678 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) / RQD (%)	TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
LIMESTONE, light brown to tan to light gray, moderately hard, highly to intensely fractured *(continued)* -becomes highly fractured from 30 to 36 feet						97 / 65	UC	107.40		10	125		
-becomes slightly to moderately fractured from 36 to 44 feet -becomes light gray at 37 feet		35				100 / 84	UC	170.13		6	130		
		40				99 / 99	UC	182.98		8	134		
-becomes moderately fractured from 44 to 50 feet		45				100 / 97							
50.0	628+/-	50											

Boring Terminated at 50 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 27 feet; Wet Rotary 27 to 50 feet

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
No free water observed

Terracon
5307 Industrial Oaks Blvd., Suite 160
Austin, Texas

Boring Started: 7/16/2014	Boring Completed: 7/16/2014
Drill Rig: Mobile B-59	Driller: Core Tech Drilling, Inc.
Project No.: 96145137	Exhibit: A-6

APPENDIX B

LABORATORY TESTING

Laboratory Testing

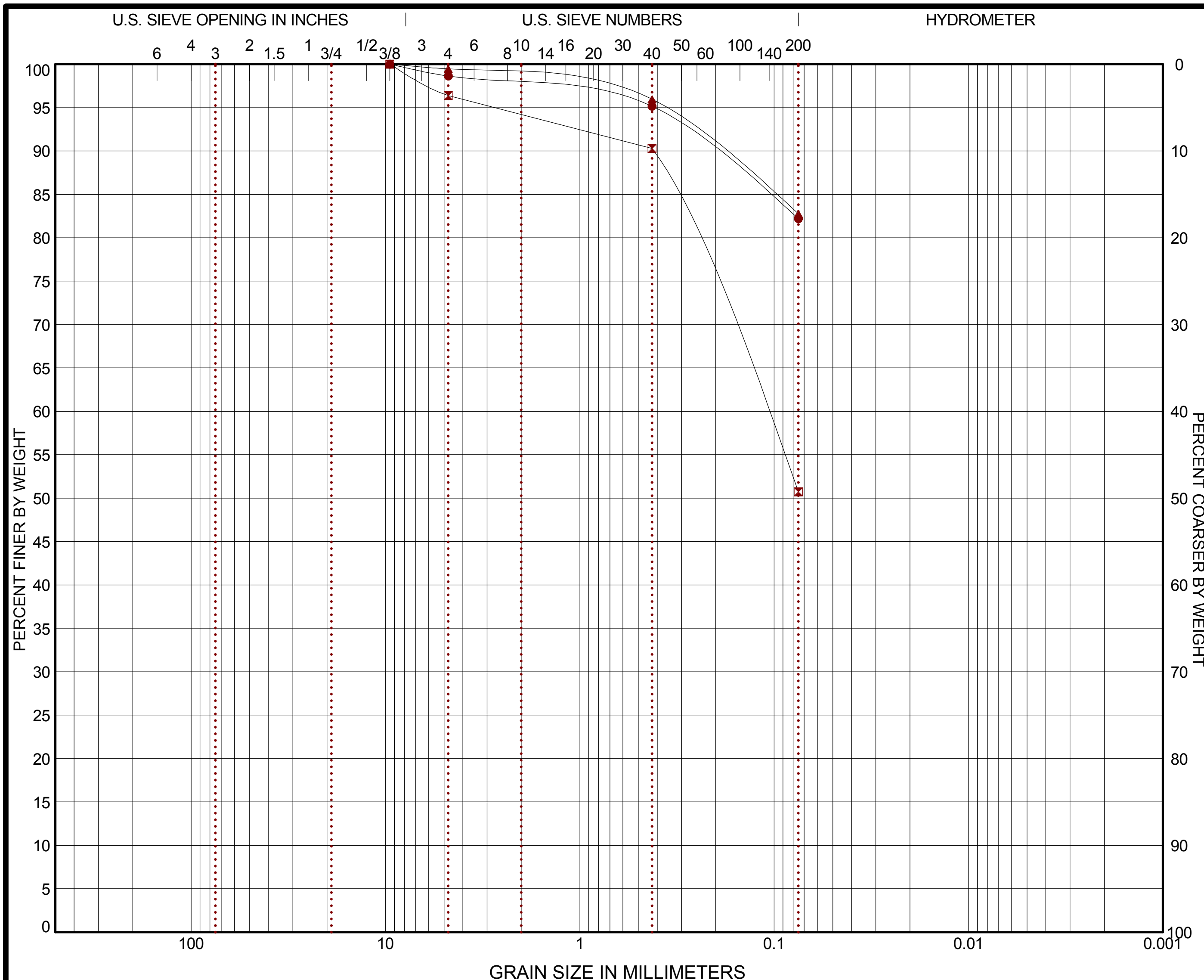
Samples obtained during the field program were visually classified in the laboratory by a geotechnical engineer. A testing program was conducted on selected samples, as directed by the geotechnical engineer, to aid in classification and evaluation of engineering properties required for analyses.

Results of the laboratory tests are presented on the boring logs located in Appendix A, in Appendix B, and/or are discussed in **Section 3.0 – Subsurface Conditions** of the report. Laboratory test results were used to classify the soils encountered as generally outlined by the Unified Soil Classification System.

Samples not tested in the laboratory will be stored for a period of 30 days subsequent to submittal of this report and will be discarded after this period, unless we are notified otherwise.

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**B-1**	**13 - 15**	**0.0**	**1.4**	**16.4**		**82.2**		**CL**
⧗	**B-2**	**0 - 2**	**0.0**	**3.6**	**45.7**		**50.7**		**ML**
▲	**B-2**	**6 - 8**	**0.0**	**0.5**	**16.7**		**82.8**		**CL**

	GRAIN SIZE		
	●	⧗	▲
D_{60}		**0.113**	
D_{30}			
D_{10}			
	COEFFICIENTS		
C_C			
C_U			

SIEVE (size)	PERCENT FINER		
	●	⧗	▲
-1 1/2"			
3/4"			
3/8"			
#40			
#200			

SOIL DESCRIPTION
- ● LEAN CLAY with SAND(CL)
- ⧗ SANDY SILT(ML)
- ▲ LEAN CLAY with SAND(CL)

REMARKS
- ●
- ⧗
- ▲

PROJECT: VA Hospital Surgery Addition

SITE: 1901 South First Street
Temple, Texas

Terracon
5307 Industrial Oaks Blvd., Suite 160
Austin, Texas

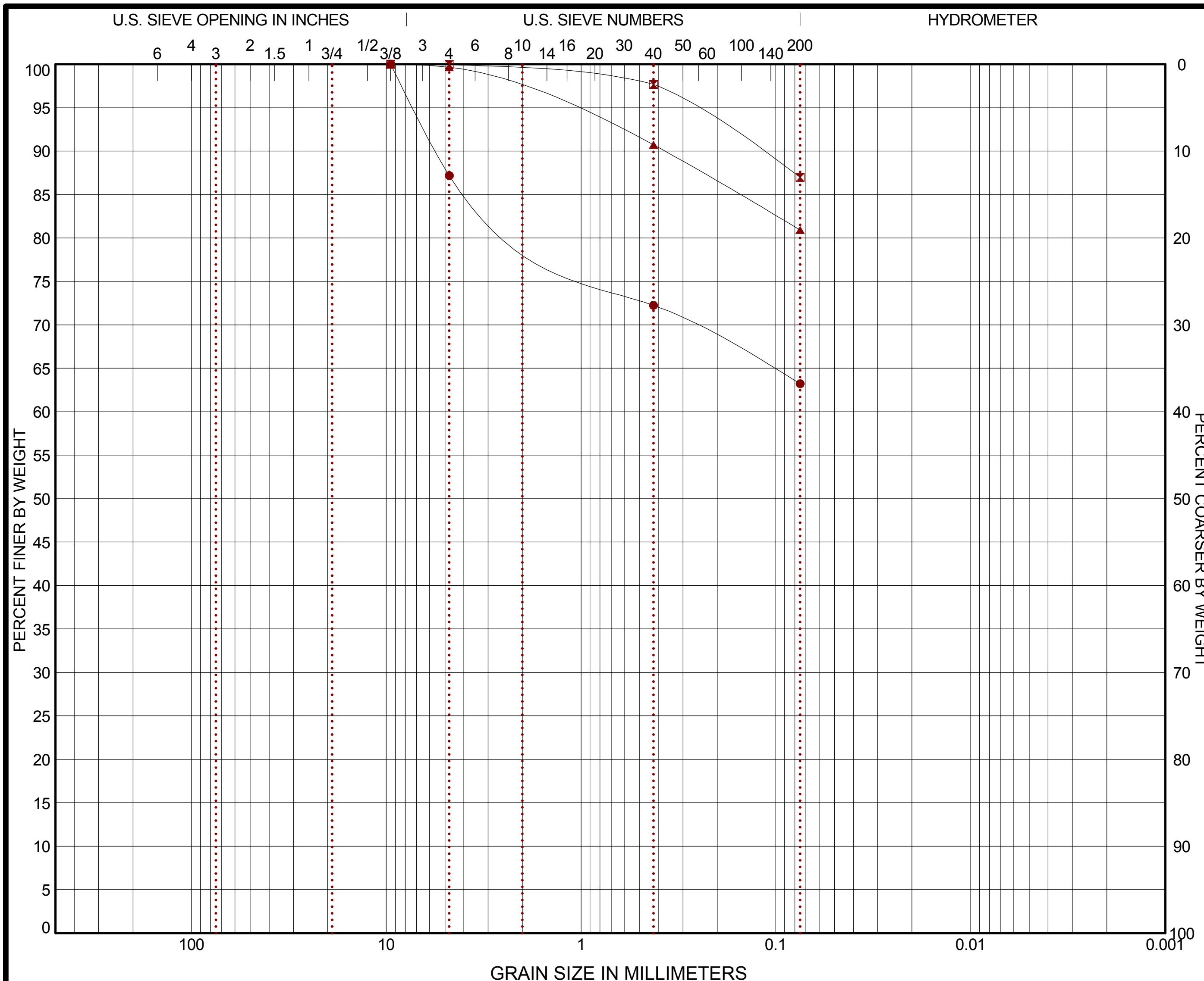
PROJECT NUMBER: 96145137

CLIENT: Brewer & Escalante
Houston, TX 77040

EXHIBIT: B-2

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**B-3**	**4.5 - 6**	**0.0**	**12.8**	**24.0**		**63.2**		**CH**
⧗	**B-3**	**18 - 20**	**0.0**	**0.0**	**13.0**		**87.0**		**CL**
▲	**B-3**	**23 - 25**	**0.0**	**0.3**	**18.7**		**80.9**		**CL**

	GRAIN SIZE		
	●	⧗	▲
D_{60}			
D_{30}			
D_{10}			
	COEFFICIENTS		
C_C			
C_U			

SIEVE (size)	PERCENT FINER		
	●	⧗	▲
-1 1/2"			
3/4"			
3/8"			
#40			
#200			

SOIL DESCRIPTION

● SANDY FAT CLAY(CH)

⧗ LEAN CLAY(CL)

▲ LEAN CLAY with SAND(CL)

REMARKS

●

⧗

▲

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EXHIBIT: B-3

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING	WATER LEVEL	FIELD TESTS
Rock Core Shelby Tube Split Spoon	**Water Initially Encountered** **Water Level After a Specified Period of Time** **Water Level After a Specified Period of Time** Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	**N** — **Standard Penetration Test Resistance (Blows/Ft.)** **(HP)** — **Hand Penetrometer** **(T)** — **Torvane** **(DCP)** — **Dynamic Cone Penetrometer** **(PID)** — **Photo-Ionization Detector** **(OVA)** — **Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		**CONSISTENCY OF FINE-GRAINED SOILS** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			**BEDROCK**	
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1	< 20	Weathered
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4	20 - 29	Firm
Medium Dense	10 - 29	Medium-Stiff	0.50 to 1.00	4 - 8	30 - 49	Medium Hard
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15	50 - 79	Hard
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30	>79	Very Hard
		Hard	> 4.00	> 30		

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

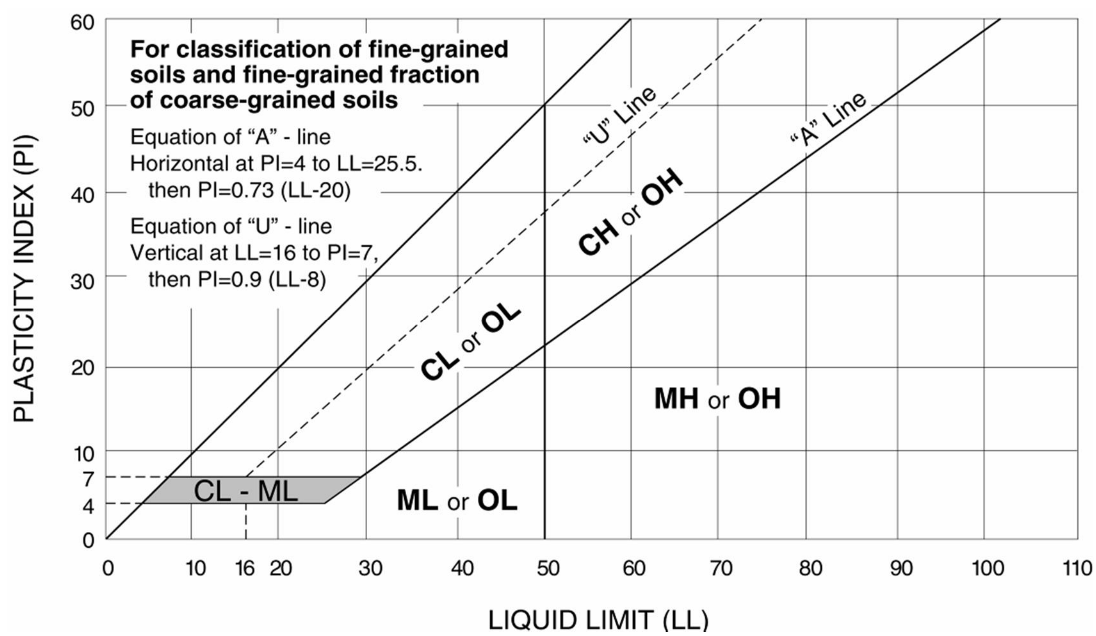
UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]	GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]	SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G,H,I]
			Fines classify as CL or CH	SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]	CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [K,L,M,N]
					Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K,L,M]
			PI plots below "A" line	MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [K,L,M,P]
					Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve
[B] If field sample contained cobbles or boulders, or both, add "with cobbles and/or boulders" (or both) to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10} \qquad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.



DESCRIPTION OF ROCK PROPERTIES

WEATHERING	
Term	**Description**
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, PSI (TSF)**
Extremely weak	Indented by thumbnail	40-150 (2.9 – 10.8)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (10.8 – 50.4)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (50.4 – 288)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (288 – 504)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (504 – 1,080)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (1,080 – 2,592)
Extremely strong	Specimen can only be chipped with geological hammer	> 36,000 (> 2,592)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (< 19 mm)	**Laminated**	< ½ in (< 12 mm)
Very close	¾ in – 2½ in (19 – 60 mm)	**Very thin**	½ in – 2 in (12 – 50 mm)
Close	2½ in – 8 in (60 – 200 mm)	**Thin**	2 in – 1 ft (50 – 300 mm)
Moderate	8 in – 2 ft (200 – 600 mm)	**Medium**	1 ft – 3 ft (300 – 900 mm)
Wide	2 ft – 6 ft (600 mm – 2 m)	**Thick**	3 ft – 10 ft (900 mm – 3 m)
Very Wide	6 ft – 20 ft (2 – 6 m)	**Massive**	> 10 ft (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0 degree angle.

ROCK QUALITY DESIGNATION (RQD*)	
Description	**RQD Value (%)**
Very Poor	0 – 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 – 100

*The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009 Technical Manual for Design and Construction of Road Tunnels – Civil Elements